REPORT OF

TENTH ANNUAL
Date Grower's Institute

HELD IN

COACHELLA VALLEY

CALIFORNIA

APRIL 8, 1933

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Tenth Annual

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Experiments With California Dates In Storage

By Wm. R. Barger, U. S. Bureau of Plant Industry, Indio, California

FRUIT storage has become an important part of the handling and marketing of dates. In 1926 around one-sixth of the crop or about 100,000 pounds were stored in order to spread the packing time more evenly over the season.

Most of the present crop of around 3,500,000 pounds were placed at one time or another into cold storage either for the purpose of spreading the packing operations over a longer time or for holding packed fruit for a better market. The localities that are now supplied with California dates apparently cannot consume the crop during the four months closest to the harvest and so storage is being used more each year to hold part of the crop for the February and March market and for marketing after March. Cold storage has an advantage over ordinary storage at higher temperatures because cold rooms are free from insect pests and the fruit does not change or deteriorate rapidly when cold.

Although proper conditions of temperature and humidity for the storage of dates in field boxes before packing are as exacting as the conditions needed for packed fruit, any deteriorated unpacked fruit can be graded out without excessive cost over normal handling and packing while deteriorated packed fruit carries with it the cost of packing labor and material. It seems, therefore, that the conditions needed for the successful storage of packed dates should be well understood.

This paper will deal with observations of packed dates in cold storage. Most of the fruit was packed in commercial 8 oz. packages wrapped with cellophane and stored in commercial shipping cases containing 15 to 24 packages. Several of these cases were placed in commercial cold storage rooms having temperatures of 0° F. to 40° F. Usually a pound or so of fruit from each lot was held in a tightly sealed jar in the laboratory at a temperature of about 70° F. At the start of each storage test representative fruits from each lot were ground up and preserved for analysis of moisture and sugar. At intervals during the storage period the fruit was inspected for appearance and general quality and samples were preserved for analysis. The gain and loss of weight of the packed fruit was also measured. The analytical work is not completed so all the data is not available at this time.

The general effect of temperature on inversion of cane sugar, formation of syrup and darkening of the color of dates is well known. These changes take place rapidly in most dates at temperatures above 80° F. and are slowed up by lowering the temperature. It takes a couple of days to cool dates in shipping cases or field boxes to the temperature of the storage room air even when only a few boxes are placed in the room. If warm fruit is stacked in large blocks immediately upon arrival in storage, that is, placed in permanent stacks, the cooling of the inside fruit is not fast enough to stop the reactions that are active in warm fruit, and inversion of sugar, formation of syrup, darkening of color will continue at a relatively high rate as long as the fruit is warm. Souring and molding can start if the fruit does not cool fast enough. Pre-cooling of the fruit before stacking can be accomplished by letting groups of cases such as a load on a lift truck platform stand in the storage room a day or so before permanent stacking is made. This deferred stacking in the room effectively removes the initial heat and requires less handling than the pre-cooling of fruit in a separate room.

The fact that dates absorb moisture readily is also known, but the degree of deterioration due to moisture absorbed in storage is probably underestimated. From tests made at temperatures of 32° and 70° F. with chambers varying in relative humidity produced by the Regnault and Sorel series of mixtures of sulphuric acid and water, it appears that air with a relative humidity as low as 65 to 70 per cent is necessary to keep dates at a constant weight, and in air of 58 per cent relative humidity the fruit does not dry out more than 2 per cent a month. At a relative humidity of 82 per cent and above, which is commonly found in cold-storage rooms, dates may absorb 1½ per cent of moisture in a month at 32° F. and the same amount in two weeks at 70°.

Dates held in storage rooms at 26° to 28° F. have absorbed moisture but at a slower rate than at 32°. Very little change in moisture has been found during storage at temperatures of 18° and 0° Packages of cured dates often absorb enough moisture during three months in 40° rooms to mold in storage. Dates high in moisture content have been found molded at 32° Temperatures below 32° seem to be necessary to control mold on moist dates.

In discussing the effect of different storage temperatures upon dates of the varieties experimented with, namely; Halawi, Khadrawi, Zahidi, Deglet Noor, and Saidy, a distinction between non-cured fruit and cured fruit of the same variety based on moisture content will be made, because cured and non-cured fruit behave differently in storage.

The main storage trouble effecting Halawi, Khadrawi, Zahidi, and Saidy dates is "sugar spot" which is the result of the crystalization of sugar from the syrup underlying the skin and the slow accumulation or growth of these crystals into masses the size of small pills. These gray-white pills under the skin, constituting as much as 20 per cent of the weight of the flesh, give the fruit a spotted appearance which is objectionable. Commercial "freezer" storage in which a temperature between 0° and 10° F. is maintained has kept these varieties without spotting for a much longer period than higher temperatures.

Cured Halawi, Khadrawi, and Zahidi dates, of 13 to 20 per cent moisture produced sugar spots in four to six months at 32° F., in six to ten months at 18°, and were good for a year at 0°.

Non-cured Halawi, Khadrawi, and Saidy with 20 to 30 per cent moisture, spotted in one to three months at 32°, in four to six months at 18°, and so far have not spotted in six months at 0°. Spotting occurred sooner at 40° and some later at 27° than at 32°.

The fruit not protected from the moist air of the storage rooms by tin or glass containers or moisture-proof wrappers absorbed moisture at

temperatures of 27° and above, and so the separate effect of temperature and moisture alone on spotting of all lots is not shown. Probably the absorption of moisture by the fruit only shortens the time for sugar spots to form and is not necessary unless the fruit is low in moisture. This seems to be true from the fact that spotting occurred readily on non-cured fruit and later on cured fruit held in cans where the change in weight during storage was very slight.

Spotting at store temperage of around 70° F. does not seem to be common and this is probably due to the drying out of the fruit. Transparent crystals of sugar form under the skin during warm storage but spots do not commonly form unless the fruit is kept from drying out. Moist non-cured fruits held under these conditions mold before spotting occurs.

In discussing the effect of storage temperature on Deglet Noor dates, a separation will be made not only between cured and non-cured fruit but also between cane sugar and invert sugar types of Deglet Noors. Vinson* and Sievers and Barger** report analyses of some Deglet Noor fruits of the dark soft class containing one-third or more of the sugar as invert sugar, whereas most of the fruits have less than one-third of the sugar inverted. These analyses show the existence of two distinct classes of Deglet Noor dates. Packers have also recognized for some time a difference between the dark soft class and lighter colored less syrupy class. Both are good dates but the dark soft Deglet being high in invert sugar should be handled in storage more like soft dates for they readily become syrupy and even sugar spot.

Sugar spotting, however, cannot be used to signify the end of storage life of Deglet Noor dates because the cane sugar type does not spot and the invert sugar type is apt to become dark and syrupy to an objectionable degree before it spots. The color of Deglet Noor fruits slowly darkens in storage and there is a gradual formation of syrup if the fruit does not dry as it ages.

Description of quality and appearance as good, fair, and bad, used in the investigation and meaning degree of objectionably dark color and of objectionable syrup, is based on a relative comparison between the fruit in question and check fruit of the same lot from low-temperature storage showing little or no change during the storage period. It is possible that the sugar analyses will show excessive inversion of sugar in the "bad" fruit and point to a chemical standard that can be used.

Cured light-colored Deglets with 17 to 23 per cent moisture became dark and syrupy after six months at 40° F. but were good for six months at 32° and 27°. Little or no change was apparent for a year at 18° and 0°. Cured dark soft fruit darkened to mahogany color and became objectionably syrupy much faster than light colored fruit and was considered bad in three to four months at temperatures from 17° to 40°. At 0° this fruit remained good for six months and fair for a year.

Non-cured Deglet Noor dates with 24 to 30 per cent moisture and light in color were darker and more syrupy at 27° to 40° than at 0° after four to six months. Very little change seemed to take place in six months at 18° and 0° and the fruit was fair after a year at 0°. Non-cured dark soft fruit became objectionably dark and syrupy in four months at 18° and warmer, remaining good for six months at 0° and was fair after a year at 0°.

The flavor of the fruit changed little at the lower temperatures for six months, but a gradual loss of flavor and accumulation of storage taste occurred during a year's time. Perishable fruits seldom improve with age in storage but dates can be held a long time before they become bad at low temperatue.

The question of dates "sweating" on removal from cold storage cannot be overlooked. The condensation of moisture upon cold packages is not harmful provided the packages are allowed to warm thoroughly before opening. The moisture in this case collects on the outside of the package and can be dried before it penetrates to the fruit. Rapid warming of the fruit to a temperature above the dew point of the air and drying of the collected moisture are aided by air circulation around the packages during warming.

Stored dates seem to be no more or less perishable after storage than dates of a similar grade not subjected to low temperature. The fruit may change in grade during storage, especially at the higher temperatures, but change or deterioration in grade after removal is no more rapid than normal. Storage temperatures of 0° to 10° F. have reduced chemical and physical changes in the fruit to a minimum and have prevented molding and souring during storage, but they have not killed the fruit or the contaminating spores and normal life, and the causes of molding and souring revive after storage.

Of course cured fruit does not mold or sour readily unless it has picked up enough moisture in storage to place it in the non-cured class. Non-cured fruit readily molds and sours after storage and must either be cured before marketing or be held under proper conditions at the market. Tender non-cured fruit has been kept over a month in a 20° F. ice cream cabinet without darkening in color, molding or losing much moisture.

The greatest deterioration of cured fruit at the market seems to be drying out. No container or wrapping material designed to reduce the drying of the packed fruit will insure high quality fruit to the consumer as much as frequent small deliveries of fruit to the retailer from proper storage. The use of wrappers and containers as an aid in reducing drying of packed fruit has been tried and the amount of drying can be materially reduced by using moisture-proof wrappers or metal containers.

Moisture-proof wrappers cannot be removed if it is found that a few doubtfully wet dates have been placed in the package but the use of an auxiliary metal container which may be large enough to hold several shipping cases furnishes a means of holding cured fruit with little drying while the wetter packages can be held outside until properly dried. This suggests the possibility of placing packages with ordinary wrappers in moisture-proof shipping cases.

In summarizing the results of the storage experiments to date, rapid cooling of the fruit to the temperature of the cold storage room is necessary for the immediate retarding of ripening and deterioration.

Halawi, Khadrawi, Zahidi, and Saidy dates if cured before storage have kept until Christmas at 32° F. without forming sugar spots, but "freezer" temperatures were necessary to keep them until March. Tender non-cured fruit required 0° to 10° temperature for even short storage.

Absorption of moisture in storage apparently hastened the formation of sugar spots. The dark soft invert sugar type of Deglet Noor reacted in storage similar to invert sugar dates while the lighter colored cane sugar type of Deglet Noor was preserved

*Vinson, A. E., 1911. Chemistry and Ripening of the Date. Ariz. Agr. Expt. Sta. Bul. 66:403-435, illus.

**Sievers, A. E., and Barger, W. R., 1930. Experiments on the Processing and Storage of Deglet Noor Dates in California. U. S. Dept. Agr. Tech. Bul. 193.

with little change in storage at a higher temperature than that needed to preserve invert sugar dates.

Cured cane sugar type Deglets kept well for six months at 32° and for a year at 18°, while non-cured fruit of this type required 18° for six months storage and 0° for a year. Cured invert sugar type Deglets stored at 18° until Christmas without turning objectionably dark in color or objectionably syrupy but needed 0° storage for six month's holding. Non-cured soft Deglets needed 0° storage to be held for six months.

Commercial cold storage rooms, especially those used for mixed fruits, usually have a much higher relative humidity than the 65 to 70 per cent needed to keep dates from absorbing moisture. The advantage of using rooms in which dry air can be maintained or of using separate rooms for dates when temperatures of 26° F. and above are used, is indicated. At temperatures of 18° and 0° little change in the moisture of the fruit was observed and so these low temperatures offer the double benefit of preserving quality and moisture.

The use of moisture-proof fruit containers or wrappers minimized the deterioration due to absorption of moisture in storage and loss of moisture after storage.

Combination Culture of Dates and Citrus

By H. J. Webber, Citrus Experiment Station, Riverside, California

THE first combination planting of citrus and dates in California, of which the writer has knowledge, was that made by the Tropical Date Gardens at Thermal which is now under the direction of Mr. Robbins Russel. This planting was planned and executed under the direction of Mr. F. O. Popenoe who probably first obtained the suggestion through the practices pursued in the date regions of Mesopotamia and Egypt.

I visited this planting first in company with Mr. Popenoe in 1915 while the trees were still young. It was a planting of dates, set approximately 30 feet apart each way, with grapefruit trees interset midway between each date in the east-west rows. Both were set at approximately the same time. By the time these dates and grapefruit were five to six years old they had grown together so that the foliage was interlocking. In the succeeding ten years, which were trying ones for the American date industry as a whole, this combined planting was not considered very satisfactory. So far as I have learned this was largely due to the interference of the tops of the dates and grapefruit which resulted in badly torn and ragged leaves and badly scarred fruit particularly on the grapefruit trees. There was some talk in the valley during this period about combined planting but this one trial grove was not sufficiently successful to stimulate further interest and experimentation.

At the first Date Institute held in 1924, the writer in his address opening the meeting discussed shortly the method of combination culture of dates and citrus, and advocated more extensive trials. He called attention at that time to the probability that this method of culture to be successful would necessitate delaying the planting of the citrus trees for several years until the date trunks had gotten up a short distance so that the crown of foliage would be above and out of the way of interference with the citrus trees.

As would naturally be expected this statement unsupported by local evidence caused no rush to interplant the date gardens. It did, however, have one very valuable effect. Mr. Robbins Russel informed the writer several years later that at the time the 1924 Institute was held he was planning to remove all of the grapefruit trees interplanted in his date gardens but that after hearing the writer's discussion he decided to retain the planting in order to obtain further experience. It is my understanding that he is now satisfied to retain the combination planting, but I hope he will make a personal statement relative to his conclusions during the discussion of this paper.

The next step in the progress of combination culture came in the spring of 1928 when Dr. H. S. Fawcett desired a few citrus trees to plant as soil indicators in decline disease spots in certain date gardens. At that time the writer was sending grapefruit trees to Brawley to be planted in a rootstock experiment and the idea was immediately suggested to him that the planting for Dr. Fawcett's disease work could be extended to make a small experimental trial of the combination culture method. This was done, as the majority of you doubtless know, in the date gardens of Gillette-Rosenberger at Indio and of Mr. H. H. Middleton below Thermal. In these two gardens of good-sized palms with trunks about ten feet high or more, rows of Marsh grapefruit, Valencia and Washington Navel orange on several different rootstocks were interplanted in such a way that they extended entirely through the gardens and at the same time through the decline spots.

These trees have this spring entered their sixth year of development, and have made a fine growth. No careful comparative study of their size and yield has been made, but this is not necessary to determine that the trees have made a fairly good and satisfactory growth. It has also been clearly evident that they have produced fair yields of good fruit. No statements have been published regarding these trees and no discussions of them presented in public meetings. It has not been necessary to spread a knowledge of the results as the trees talk for themselves. I presume that most of the date growers of California have visited and examined these experimental plantings and have themselves judged the results.

As a direct influence of these small experiments and of the indications given in recent years by the combined plantings in the Tropical Date Garden the promise of this method of culture has become generally recognized. During the last three years a large number of date gardens have been thus interplanted with grapefruit and the method of combination culture of dates and citrus may thus be said to be well launched.

The commercial success of the policy of interplanting citrus in date gardens, however, cannot as yet be affirmed with certainty. It can only be suggested as a method having sufficient promise to justify its ex-

tensive trial. It is the type of problem that cannot be solved in the quiet of one's office, it can only be solved by actual experience. It is therefore important at this time to question whither we are drifting and what we can do to control the direction taken. Many horticultural ventures crash on the rocks of disaster from lack of thoughtful planning.

A few months ago while on a trip to Oasis the writer stopped at a date garden that was in process of being interplanted with oranges and grapefruit. Incidental inquiry elicited the information from one of the workmen that the trees being planted were all propagated on sweet orange rootstocks. Immediately it flashed into mind that this was one thing not to do in a combination planting of dates and citrus, and this is the reason the writer is appearing on your program today.

A date grower contemplating interplanting his garden with grapefruit or oranges will naturally seek information and advice relative to the varieties and rootstocks giving the most satisfactory results. Presumably he is not a citrus grower and is not informed sufficiently to question the advice given him by a successful citrus grower or nurseryman. This advice will be given in good faith and will likely be correct for the citrus industry of the state but this does not consider culture of citrus with dates. The citrus man is not familiar with date culture but he knows citrus.

Until a few years ago the rootstock most generally used in California for all commercially grown citrus varieties was the sour orange. In recent years, however, there has been a general drift toward sweet orange stocks. It is probable that the majority of nurserymen today if consulted relative to the best general stock to use for orange and grapefruit varieties would be inclined to recommend either sweet orange or sour orange but with a slight preference in favor of the sweet orange. In the writer's rootstock experiments embracing trials with some 40 different rootstocks, the sweet orange in general has up to date given the largest trees and the best yields.

Why then condemn the sweet orange rootstock for use with trees to be interset in date gardens. The reason for this is that the area to be planted is primarily a date orchard and must be irrigated, tilled, and handled as a date garden. If the area is to be handled as a citrus orchard the dates may as well be pulled out immediately. The date grower must therefore adapt his citrus trees to date culture, not the dates to citrus culture.

The experience of date growers indicates that very heavy irrigation is necessary to insure success. Application of from 15 to 18 acre feet per year are frequently used, whereas, citrus growers rarely use a maximum of over three acre feet and commonly not more than from 1½ to 2½ acre feet. It must be further remembered that the citrus trees are to be grown in the shade of the date trees. In this combined culture there will thus be long periods when the citrus trees will be growing in moist or even wet soil and where the humidity will be much higher than in normal citrus orchards because they are grown as an under-crop in the shade.

These are conditions which all citrus experience indicates are conducive to infections of foot rot or mal di gomma, a dread disease that causes severe loss in all humid regions and some considerable loss even in the arid sections of California. This disease attacks the crown roots at the base of the trunk at or near the surface of the soil and the sweet orange is very susceptible to infection.

I am not aware that foot rot has appeared as yet in the Coachella Valley but it is spread all over the main citrus sections of California and the United States and is certain to get to the Coachella Valley shortly if it has not already been introduced. If, therefore, sweet orange stocks are used for the propagation of trees to be planted in a date garden it would seem certain that they will ultimately be seriously injured and perhaps destroyed outright by this malady or some other of the numerous root rots that appear in rather too moist soils. Under the conditions existing in a date orchard it would be difficult or impossible to apply the control methods ordinarily successfully used.

In the writer's judgment this would be a "knock-out blow" to combination culture if there existed no alternative policy. Fortunately, however, we have only to point out that the sour orange which has been used very successfully with all orange and grapefruit varieties is very resistant, or almost totally immune to this disease and is already more extensively used in the citrus orchards of the Coachella Valley than any other stock. It seems to be clearly evident, therefore, that **all citrus trees to be used for interplanting in date orchards should be propagated on sour orange rootstocks.**

It should also be pointed out that in having to use sour orange stocks the grower need not conclude that his grapefruit or orange trees will be laboring under a severe handicap. Up to the present time it may, I think, be safely stated that the best grapefruit groves in the state are on sour orange and certainly also many of the best navel and valencia groves are on this stock. It is, furthermore, known to produce as high a quality of fruit as any other stock. All in all, it is still an open question whether any other stock will as a whole give better results than the sour orange for grapefruit and orange varieties.

A second matter to which attention should be emphatically directed is the height of budding. If the full benefit of using a stock resistant to foot rot and similar gummosis diseases is to be achieved it is necessary that the bud union, where the susceptible sweet trunk begins, should be well above the ground. Other than from the standpoint of disease prevention it is a matter of indifference, so far as is known, whether the trees are budded high or low. The majority of citrus nurserymen insert the buds at approximately four to six inches above the crown roots. It would be far safer and better for date garden planting if they were budded at eight to ten inches above the crown roots. The writer would suggest that date growers purchase for interplanting only trees on sour stocks budded from eight to ten inches high. Speak to your citrus nurseryman early so that he can propagate the trees you want in the proper way. You will not get what you should have unless you make it a positive condition of purchase.

Still a third factor that should be emphasized is the necessity of high planting. It is important especially when citrus trees are to be planted in soils that tend to be slightly too moist that they be planted high so that the bases of the crown roots as the trees become large will be even with, or slightly above the surface of the soil.

In the lateral roots of citrus the layers of growth are much thicker on the upper than on the lower surface and thus when the lateral roots of a nursery tree are placed about two inches below the surface, which is approximately the correct location, they ultimately, by their growth in size, come to the surface or slightly above at the point where they join the trunk.

Little attention is given by plant-

ers generally to the settling of the soil and the result is that at least half of the citrus trees in the state are planted too deep to be the safest from injury and to give the best results. Most growers use a planting board to gauge the height of setting and aim to place the trees at the same relative height they occupied in the nursery. The top of the root ball is thus pulled up against the bottom of the planting board and the earth tamped in around the ball. The soil then settles from two to four inches depending on the texture of the soil and the depth of the hole so that finally the tree is too deep.

To avoid too deep planting it is usually advisable in preparing the land for planting to back-furrow the soil forming a low ridge on which the trees are to be planted. By this means the surface level of the soil is slightly raised and then when the trees are planted at the regulation height with a planting board they will finally settle to approximately the correct level.

Trees that are set at the correct height are less subject to injury by foot rot and other root diseases and while this is an important factor in all citrus culture it is believed to be especially important in plantings of citrus with dates. Under the arid conditions of California if the trees are not set much too deep and are not over watered they may grow fairly well but deep setting is never desirable.

Perhaps it should be stated also that too high setting should be avoided but in many years of experience the writer has never observed a grove that has been injured in this way. Many groves have been injured in places by the washing away of the soil so that the trees are left too high out of the ground, just as portions of many groves have been injured by the filling in of the soil around the trees.

Summarizing, the writer would state that he believes that trees of grapefruit, orange, or tangerine designed for interplanting in date gardens should be budded from eight to ten inches high, on good sour orange stocks, and that more than ordinary care should be used to see that they are planted at the proper height.

Discussing the subject of combination culture in its broader sense the writer would state that the idea is one that for many years has greatly interested him.

It is almost invariably the case the world over that numerous plants of different species mingle together in their natural environment. Under the large tall species, like the trees, we usually find growing small trees and shrubs as underbrush and still under these the immediate surface covering of small herbs of various kinds.

The larger members of any particular plant association require full light intensity for their most satisfactory growth while the underbrush and small trees growing with them develop successfully in partial shade and the small low herbs in rather dense shade.

The citrus species commonly cultivated are small trees and in their natural habitat grow as underbrush or under trees in humid forests of subtropical and tropical regions. They are usually found on rather low moist lands and along river banks. It is astonishing, therefore, that under domestication they can succeed as they do in warm arid countries under the system of mono culture where they get the full intensity of the sunlight and the full influence of the low humidity.

Since the writer first began to study citrus culture, over 40 years ago, he has been interested in learning what effects would result if some system of combination culture was adopted which would permit the growth of citrus as an under crop in partial shade.

In Florida a partial application of this system was followed in many cases as the easiest method of utilizing the wild sour orange groves which covered thousands of acres in that state when citrus culture was first starting. The method consisted in thinning out the primeval forest, felling and removing a considerable number of the forest trees as well as many of the citrus trees and all of the undergrowth. The orange trees were thinned to the desired spacing and were then top-worked with the varieties desired. Almost all of the palmetto palms and a few of the large live oaks, magnolias, bays, and hickory trees were left standing here and there and when the thinning was completed the groves presented the appearance of an open forest of large trees with an undergrowth of citrus.

These worked-over wild groves were on low, rick, moist hammock lands and they have come to be recognized as the best groves in Florida producing good yields of the highest quality fruit. The very high quality of the fruit produced in such groves under partial shade and where the humidity remains high is especially noteworthy. It is also noteworthy that under those conditions the orange trees that happen to be very near to palmettos or large oak trees are just as large and productive as those farther away. Evidently the moisture and nutrition available in these soils or made available through fertilization, is sufficient to supply the needs of all the trees and the orange trees are benefited by the shade rather than injured. It also appears that the palmettos and other forest trees that have been permitted to remain in the groves have been benefitted by the changed conditions rather than injured.

At DeLand, Florida, in the famous Stetson Estate successful large orange groves may be seen which were planted in the midst of an old forest of the long-leaf pine. Only those pines were removed that were in the places where orange trees belonged in the plan of planting, and amounted to a removal of only about one-third of the original pine trees. Here successful groves are maintained with pine trees towering over them and with the soil beneath carpeted with bermuda grass and crab grass which is kept down by mowing. Certain successful growers in Florida may thus be said to have returned to natural methods of orange grove maintenance.

These examples have no point of value probably from the standpoint of citrus culture in general in California but they do furnish evidence indicating the probable success of citrus culture in date gardens and suggest that the fruit produced is likely to be of high quality.

While the evidence is yet too fragmentary to permit a positive conclusion as to the degree of success of combined culture of dates and citrus it may be stated that all the evidence thus far obtained, that has come to the attention of the writer, is entirely favorable. It is highly important that growers having combination plantings give careful attention to the influence produced on the dates. This is a factor on which little information is available and which must be carefully considered.

Growth Rate of Deglet Noor Dates

By Carl L. Crawford, Assistant Scientific Aide, U. S. Experiment Date Garden
Indio, California

THE growth rate of Deglet Noor dates was studied at the U. S. Experiment Date Garden, Indio, California, during the season of 1932 by measurements and weights of fruit and seed at intervals of two weeks.

Twelve bunches of dates were selected for the measurements. Six of them, designated as Group A, all on a single 19-year-old palm, were pollinated on the same date, March 15. The remainder of the bunches (Group B) were on four palms nine years old and were pollinated in the six-day period March 30 to April 4. Five bunches in each group were used for the measurements, with the extra bunch included for substitution if needed. Pollen from the same male was used throughout.

Measurements were begun on May 3 in each group and were continued until ripe dates were picked, or until September 6 on Group A and October 4 on Group B.

On the measuring days, fifteen of the largest dates of normal appearance were carefully picked from each bunch. From each of the ten samples ten of the most normal dates were selected for measurement. Each lot of ten dates was weighed. Next each date was measured, length and breadth, with calipers, after which the seeds were removed, weighed and measured. At the beginning the seeds were found to be too small and tender for measurement and it was not until May 17 on Group A and May 31 on Group B that this could be done with success. It was necessary, even until mid-season, to exercise great care in removing the seeds so that they should not be injured past the possibility of measurement. Measurements were made to one-tenth of a millimeter and weights to one-hundredth of a gram.

In summarizing the data obtained during the season each group was considered separately, since Group A was pollinated earlier and showed a tendency to mature in less time than the later group.

The mean growth of the fifty dates representing Group A is charted in Table I, showing the length, breadth and weight of fruit and seed from May 3 to September 6. It can be seen that growth was more rapid in the earlier stages of development and that the elongation of both dates and seeds was faster than the girth expansion. There was considerable growth in the dates themselves until August 23, while the seeds reached their maximum size about July 12 and remained almost constant in this respect until August 23.

The mean growth of Group B is shown in Table II. The rapid growth in length of dates and seeds from May 31 to July 26 is shown in contrast to the rather leisurely expansion in width. The seeds reached their maximum size about July 26, while the dates continued to expand in both length and breadth until August 23.

Brief notes were made on the "coloring" of the dates as the growth advanced and it was observed that in the early group, "A," the first pink tints were seen on July 26. On August 9 all the dates showed definite traces of pink and the next fourteen days found them changing rapidly, every date being entirely red on August 23. As stated before, mature samples were taken from this group on September 6 and these dates, of course, were amber in color and mostly soft.

On Group B the first pink tints were observed on August 9 and by August 23 pink was the predominant color with few traces of green remaining. The dates changed entirely to red in the next two weeks and were softening at the ends by September 20. Mature samples were not collected from this group until October 4.

In both groups the size and weight of the entire date was greatest at approximately the time when the red color of the khalal stage was most vivid. As ripening advanced there was a marked decrease in size and weight.

TABLE I.

MEAN LENGTH, BREADTH AND WEIGHT OF 50 DATES
—1932—

	(Millimeters)				(Grams)	
	DATES		SEEDS		WEIGHT	
Date	Length	Breadth	Length	Breadth	Dates	Seeds
May 3	6.93	6.84			.22	
May 17	11.53	10.15	7.41	2.61	.74	.03
May 31	19.11	13.60	14.01	4.36	2.11	.14
June 14	27.31	16.67	21.48	6.40	4.55	.43
June 28	35.07	19.58	27.31	8.60	7.94	.97
July 12	41.31	21.49	28.78	9.15	10.95	1.27
July 26	43.48	22.28	28.81	9.00	12.29	1.27
Aug. 9	44.83	22.75	28.72	9.04	13.22	1.30
Aug. 23	45.25	23.10	29.06	9.01	13.89	1.30
Sept. 6	40.31	19.93	25.12	7.74	9.61	.88

TABLE II.

MEAN LENGTH, BREADTH AND WEIGHT OF 50 DATES
—1932—

	(Millimeters)				(Grams)	
	DATES		SEEDS		WEIGHT	
Date	Length	Breadth	Length	Breadth	Dates	Seeds
May 3	3.48	3.78			.04	
May 17	6.21	6.42			.17	
May 31	11.30	9.71	7.11	2.86	.66	.03
June 14	17.82	12.89	12.92	4.34	1.80	.13
June 28	28.52	17.06	22.34	7.04	4.80	.56
July 12	36.00	20.00	26.75	8.88	8.11	1.09
July 26	40.77	21.23	28.19	9.26	10.35	1.31
Aug. 9	42.71	22.12	27.31	9.08	11.75	1.25
Aug. 23	43.14	22.25	27.88	9.10	12.23	1.29
Sept. 6	42.17	22.21	27.57	9.17	12.36	1.28
Sept. 20	41.66	21.48	26.51	8.56	11.80	1.11
Oct. 4	37.67	19.08	24.04	7.76	8.29	.87

Ripening Dates Earlier by Using Different Pollen

By H. R. Whittlesey, Manager Krutz Ranch, Indio, Calif.

EVERY year the dates on the Krutz Ranch have been slow in ripening and the last to be delivered to the packing house. In fact, the fruit has ripened so late that it has been necessary to keep the plant open to handle the last few pickings, as was the case this year when the last dates were taken in March 17th. Had this been a wet year the loss would have been great.

To find out just how different our temperatures are from those in the Indio section records have been kept in cooperation with Mr. Dewey Moore, scientific aide at the U. S. Experiment Date Garden, and a chart prepared by him shows mean minimum temperatures somewhat lower, which accounts, in part at least, for the delayed ripening characteristic of our locality.

Since our dates have been later than those of our close neighbors and since they were using the basin method of irrigation instead of the furrow as we were, we decided to do some experimenting. In 1927 we divided the garden into three parts, using three different methods of irrigation, furrow, flood and basin, each year alternating the plots, but there was no difference in the time of ripening on any of the plots.

Thinking perhaps it was due to the amount of water used, in 1930 we tried withholding water on certain rows during the blooming period. This did affect the size and quality but not the time of ripening.

In the spring of 1931 Mr. Roy Nixon, Associate Horticulturist at the U. S. Experiment Date Garden, suggested some experiments with a pollen which he thought would ripen the dates earlier. We were glad to cooperate in making the tests. We selected two rows of eleven palms each in the part of the garden where the dates had been the slowest to ripen every year.

On both of these rows we used at the beginning of the flowering season the pollen with which most of the dates in the garden had been regularly pollinated and which comes from a vigorous male (Krutz No. 1) producing an abundance of pollen in numerous large flower clusters. When we had pollinated about half of the blossoms we switched on one row to pollen from Fard seedling males. On the other row the Krutz No. 1 pollen was continued throughout the season, but from this time on all of the blossoms on both rows were enclosed in paper bags after pollinating to lessen the intermixture of other pollen with the Fard and to make sure the flower clusters on both rows were subjected to the same conditions with the exception of pollen.

The following table gives the dates of picking, the pounds picked and the percentage of the crop represented in each pick:

Differential Pollination Experiment Krutz Garden—1931

	Krutz-Fard Pollens (103 bunches)		Krutz Pollen Only (105 bunches)	
Date	Lbs.	% of Crop	Lbs.	% of Crop
Sept. 21	124.5	8.6	124.5	8.3
Sept. 30	148.5	10.3	127.5	8.5
Oct. 13	386.0	26.7	325.0	21.7
Oct. 26	360.0	25.0	340.0	22.8
Nov. 10	256.0	17.7	235.0	15.8
Nov. 30	128.0	8.8	192.0	12.9
Jan. 8	42.0	2.9	149.0	10.0
Total . . .	1445.0	100.0	1493.0	100.0

There was a difference of only three-tenths of one per cent between the yield of the two rows in the first picking. This was what we wanted as it was considered undesirable to increase the percentage of the crop ripening in September.

It was soon noted that the bunches pollinated with the Fard pollen were beginning to ripen ahead of the others and the difference became noticeable as the season advanced.

Loss from rain damage, estimated at about 27 per cent of the crop, interfered more or less with the season's record, but in spite of that 11.2 per cent more of the crop on the row pollinated entirely with Krutz No. 1 pollen ripened after November 10th than on the row that had the Fard pollen on blossoms appearing in the last half of the flowering season. This meant in time that the crop on the Krutz-Fard row was practically cleaned up a month earlier than on the Krutz row.

In 1932 the same experiment was conducted except that we switched pollens on the two rows, using Fard on the last half of the blossoms on the row where the Krutz No. 1 alone was used in 1931 and vice versa. While most of the palms were approximately half way along in flowering when the use of Fard pollen was started there seemed to be more variation this season between the different palms and two or three palms in each row were just beginning to open their spathes at the time the change to Fard pollen was made. One palm in the Krutz-Fard row did not bloom at all so that the record covers only ten palms for this treatment as compared with eleven for the other. The smaller number of bunches this year was due to more thinning.

The difference in the ripening of the fruit, as shown in the accompanying table, was much greater in 1932 than in 1931. Due to a later season the first picking was not made until October 18th, at which time 20.1 per cent more of the crop on the Krutz-Fard row was harvested than on the Krutz row. Again the difference increased later in the season. The fruit on the Krutz-Fard row had all ripened by December 26th, while on the Krutz row 63.2 per cent of the crop was harvested after January 1st and the last picking was not made until March 16th.

Differential Pollination Experiment Krutz Garden—1932

	Krutz-Fard Pollens (76 bunches)		Krutz Pollen Only (88 bunches)	
Date	Lbs.	% of Crop	Lbs.	% of Crop
Oct. 18	435.7	28.2	166.0	8.1
Dec. 3	956.8	62.0	582.4	28.7
Dec. 26	151.2	9.8		
Jan. 16			777.6	38.4
Feb. 17			294.0	14.5
Mch. 15			205.0	10.3
Total . . .	1543.7	100.0	2025.0	100.0

The conditions of the experiment mentioned above may have had some bearing on the increased difference in ripening due to pollen in the 1932 experiment, but the principal factor was probably the later season and colder winter. A date which would have ripened in two weeks of warm weather remained on the palm for two months with very little change after the middle of December. Many of the large green bunches on the Krutz row were practically the same through January and February.

In conclusion we wish to thank the Experiment Station, Mr. Roy Nixon and Mr. Dewey Moore for their help in solving one of our major problems. With sufficient Fard pollen we should bring up the time of ripening so as to avoid damage from winter rains and reduce the cost of picking and handling.

Symptoms of Decline Disease

By Donald E. Bliss, Junior Plant Pathologist
Riverside, California

THE symptoms of decline disease are described by Haas and Klotz (2), Klotz (3), and Fawcett and Klotz (1). Since the publication of these papers, the serious nature of this malady has become increasingly evident, especially to those who are interested in the Deglet Noor variety. The disease has thus far been detected in eleven widely separated gardens in Coachella Valley, although no systematic survey has been made to determine its actual distribution. This paper is written to stress the serious effects of decline disease on the date palm and to enlist the aid of growers in the location and study of affected trees which have thus far been overlooked.

Lack of knowledge concerning the primary cause of decline disease often makes accurate diagnosis difficult. This is true especially when palms are first affected. In characterizing this malady it is not yet possible to distinguish with certainty between cause and effect. However, the appearance of badly diseased trees is so striking when compared with that of healthy trees that the grower should have little trouble in detecting decline in his own garden if any advanced cases occur.

One of the first visible symptoms of decline disease is the premature death of leaves in the lower whorls. The span of life in leaves of healthy palms is said to reach seven years in some cases. Decline disease tends to reduce both the length of life in leaves and also the rate at which new leaves appear. The reduction in number of green leaves has amounted to 80 or 90 per cent in certain cases where a comparison with healthy palms of similar age could be made. A few brown leaves may appear throughout the warmer parts of the year on healthy trees but in diseased palms a much larger number of leaves may drop within a few weeks during August and September during periods of high temperatures. The leaves turn brown throughout their length more quickly than when dying from natural causes and the petioles become tough and shrunken as they are bent downward by the weight of the leaves.

A gradual retardation in terminal growth soon becomes evident. Whereas a vigorous palm may grow two feet or more annually, a tree showing first symptoms of decline may grow nine to fifteen inches, and one which is badly diseased may show only six inches elongation or none at all. A useful method for determining yearly growth is that of measuring the distance between the bases of the fruit stalks of successive years. By October, the distance between the base of the current year's fruit stalks and the highest visible fiber line represents the greater part of elongation in the trunk for that year. These outward signs of growth are presumably an indication of activity in the terminal bud from which all leaves and fruit stalks originate. In extreme cases, the height of the terminal bud does not seem to increase, and as a result the new leaves arise from the trunk at nearly the same level.

When affected with decline disease the leaves of Deglet Noor palms develop an unnatural yellowish-green cast. In size, the leaf is reduced considerably: the petiole is narrow and weak, while the midrib and pinnae are slender and shortened. The leaf points stiffly upward, often lending a flattened and brush-like appearance to the top.

Fawcett and Klotz (1) state that "entire lack of fruitfulness eventually occurs even to the extent of failure to produce any flowers." This statement was probably based on the fact that growers frequently cut out all fruit stalks on diseased trees. Failure to produce any flowers may not be found commonly since in 1932 all of the diseased palms which were observed produced one or more fruit bunches. In a garden of Deglet Noor palms, healthy trees are found commonly with 15 to 20 bunches of dates, while diseased trees usually will have not more than ten. The spathes are small and are often late in making their appearance. The fruit stalks of sick palms are sometimes barely an inch wide and so weak that they break under a small load of fruit. The flowers are apparently normal and receptive to pollination, but the resulting fruits are practically worthless. When fruit from healthy palms is fully ripened, that from decline-diseased palms is hard, fibrous, shrivelled at the tip, and shatters easily. Fruit from recently affected palms may still be marketable but it is seldom of high quality.

The trunk, leaves and fruit of affected palms are stunted and seem to lack vigor. It is notable, however, that those portions of the tree which extend above ground are apparently free from lesions. In extreme cases as much as nine-tenths of the root system of decline-diseased trees may be dead. Decay which is commonly associated with necrotic tissues may extend from the roots into the base of the tree.

Death resulting from decline disease is as yet unknown. However, many diseased trees are now without value to their owners. Since much additional information is needed in order to learn the cause and control of this serious malady, the cooperation of the date growers in reporting the location and history of diseased trees is requested.

(1) Fawcett, H. S., and L. J. Klotz. 1932. Diseases of the date palm, Phoenix dactylifera. California Agr. Exp. Sta. Bul. 522:1-47.

(2) Haas, A. R. C., and L. J. Klotz. 1931. Nutrition and composition of the Deglet Noor palm in relation to the decline disease. Hilgardia 5:511-530.

(3) Klotz, L. J. 1931. Investigations on date palm diseases. Date Growers Inst. Ann. Rept. 8:14-18.

Report of Progress: Date Scale Eradication

By B. L. Boyden, Senior Entomologist, Bureau of Plant Quarantine, U. S. Dept. of Agriculture
Indio, California

THE fifth year of the Parlatoria Date Scale Eradication Campaign, carried on cooperatively by the States of Arizona and California and the U. S. Bureau of Plant Quarantine, is well under way and from results obtained to date a successful conclusion seems very probable.

During the calendar year 1932, 192,526 palm inspections were made in the Coachella Valley and no Parlatoria Scale found; in Arizona 52,954 palm inspections were made and one infested palm found on a previously infested property; in the Imperial Valley 55,592 palm inspections were made and 43 palms (3 date, 4 fan, and 36 Canary Island palms) found infested on six properties, 3 new and three old infestations.

To date this year no scale has been found in either Arizona or the Coachella Valley, two infested palms were found in the Imperial Valley. Since January 1, 1928, a total of 2,383 infested palms have been found on 44 properties in the Coachella Valley, 142 infested palms on 16 properties in Arizona, and 1,402 infested palms on 80 properties in the Imperial Valley.

In discussing the eradication work with growers and others I find that the slogan, "Find and kill the last bug," has given some the wrong picture of our problem. It is not a proposition of finding a single tiny insect the size of a pin head on one of several million date fronds. If it were, our chances of success would be negligible. The natural mortality among scale insects is very high, especially in the case of those newly hatched, still in the crawler stage, the only stage in which they may be transported from one palm to another and establish new infestations. Therefore, a comparatively large number of insects must be producing young before there is any great danger of spread to nearby palms and a considerable number must reach a clean palm before an infestation is established. A newly established infestation will increase in intensity quite rapidly.

To eradicate the scale in a given area we must locate the infested palms and eliminate the scale on these palms before there is any danger of spread. This I believe can be done by careful and frequent inspection and prompt treatment providing that the palms are not too bushy for effective inspection. Many thousands of bushy palms in abandoned seedling plantings have been dug out and destroyed and many commercial and ornamental palms, pruned to facilitate inspection. In this as in all eradication operations the cooperation of the owners has been excellent.

To systematically inspect the palms they must first be located, mapped, and listed. The first general survey in 1928 located most of the palms, others were located by systematic scouting in the different districts and finally an intensive scouting, taking the section as a unit, and walking over all brushy areas and irrigation ditch banks was begun. The irrigated areas in the Coachella and Yuma Valleys and the infested area in the Imperial Valley has been completed and the irrigated area in the Salt River Valley will be completed soon. Certain areas will be rechecked.

The treatment of an infested palm consists in removing all the exposed foliage except the terminal bud and running the flame of a gasoline torch over the leaf stubs or carefully spraying with an oil emulsion. When the scale is carried from one palm to another by the wind or some other means, the insects establish themselves on the exposed portions of the plants. If the infested palms are treated at this stage there is no question but that the scale is entirely eliminated or if any remain they are on the outer unfolded crown leaves and may easily be detected and removed as the leaves unfold.

In long standing infestations, however, the scale establishes itself on the leaf bases under the several layers of fiber which cover them. The heat from the torch or the spray does not effectively penetrate this fiber. In treating an infested palm the fiber is cut back and the leaf bases pruned when there are indications of leaf base infestation. In spite of every precaution, however, a few insects are sometimes left on the leaf bases and remain unobserved there until the infestation increases and the insects establish themselves on exposed tissue. Under certain conditions such infestations might remain unobserved for several years. As we have the location and history of all infested palms it is not difficult to decide which previously infested palms may possibly carry Parlatoria. We are now doing special leaf base inspection on such palms.

We believe that most of the work necessary for the eradication of the Parlatoria Scale has been done. We must, however, continue inspection until we are sure that all spread from the severe infestations found in 1927, 1928, and 1929 have been located and eliminated. We must also finish checking over previously infested palms until we are sure that no scale remains. Certain areas must be rechecked for unlisted palms, properties on which we have dug out infested plantings must be watched to locate and destroy volunteer plants coming from seed or portions of the old palms broken off under ground, ornamental palms other than date in the infested areas must be reinspected and certain areas outside the commercial date growing areas must be scouted. When these and a few other minor tasks are completed, I believe that we will be through.

Progress of Date Marketing Organization Plan

By Robbins Russel, Thermal, California

IN PRESENTING the following **Progress Report** of the general date growers committee, selected to develop a plan for the **coordinated marketing of California dates**, I shall endeavor to be as brief as possible. May I have your indulgence if, as a result, many interesting details are not covered?

The Problem

As an industry California dates have been distributed largely in compliance with the old doctrine of laissez faire. Results have been: ruinously low prices, uncertain grades and standards,—in many cases even, an apparent falling off in consumption. By reason of these and other contributing causes, returns to the date growers in the local industry have dropped so low that many producers are in distress.

History

Numerous efforts in the past few years, have been made to forestall this condition, — with partial to no success. More or less continuously during this time, the situation of the producers has become increasingly acute. During the winter just past, when standard brand California dates have sold at prices below, and sometimes far below, standard brand imported dates, as one result of numerous meetings among the principal producer groups of the industry,

a general committee consisting of Lee Anderson, Bruce Boyer, T. W. Braun, William Cook, T. J. Gridley, B. H. Hayes, J. H. Jenkins, J. E. Pippin, T. H. Rosenberger, R. Russel, D. G. Sniff, and Leonhardt Swingle, was designated to make another attempt at some form of organization of the industry. This group has received much assistance from numerous other growers whose names, for brevity, will not be mentioned.

This committee was fortunate in obtaining much helpful guidance from Dr. H. R. Wellman, Associate on the Giannini Foundation, who was able to devote practically a week at the first of March, investigating and reporting his recommendations to the date producers, as well as the hearty cooperation of Mr. M. M. Winslow, County Agent for Riverside County.

Since Dr. Wellman's report, your committee has retained counsel and devoted much time to the development of a practical program for the industry to follow, the general outlines of which are:

The Plan

A central, cooperative marketing organization to be known as **California Date Exchange** is proposed to be formed under the laws of California, **provided that by May 15, 1933,** parties who control at least ninety per cent of the date output of Coachella Valley in 1932 have executed, at the least, general agency agreements with the California Date Exchange (hereafter termed the Exchange) running for three years from date without cancellation and thereafter cancellable annually.

A further provision of this agreement is that should the Exchange fail to act as general agent for at least eighty-five per cent of the total tonnage in any year, the agreement may be cancelled by either party.

Member producers may themselves elect to sell part or all of their dates subject to the general conditions prescribed, or they may execute sales agency agreements with the Exchange to do this for them. A proviso of such sales agreements is that the Exchange shall not so engage in a sales campaign unless at least sixty per cent of the total tonnage is to be sold by it.

Voting membership in the Exchange is limited to local, non-profit, cooperative units (or associations) of date growers. Growers may join such units as they prefer. In this manner the maximum autonomy in dealing with local problems and interests, is sought to be preserved.

Such voting memberships are limited to eight in number, each of which is to speak for approximately one-eighth of the total date tonnage in the Exchange, except that no local unit, even though having more than one-half of the total date tonnage, may control more than four of the eight voting memberships. The arguments for this restriction are self-evident.

The eight representatives holding these eight voting memberships, hold office at the pleasure of the local units appointing them. They receive no remuneration from the Exchange for their services as directors, or members, and if at any time any one of them is selected for a salaried position on the staff of the Exchange, by this act he is automatically disqualified as a director and member representative and must be replaced. These eight representatives must all be bona fide date growers.

Date growers who prefer may do business directly with the Exchange under a contract shippers agreement, instead of belonging to a local unit.

The Exchange is prohibited from engaging directly in the business of producing or packing dates.

The liability of the members for debts of the Exchange is clearly and strictly limited and all advances made by the Exchange to members must be self-liquidating.

While recognizing that no radical steps should be taken by the Exchange at this time—that the growth of its functions should be gradual and not forced — it is the view of your committee that a certain minima of functions exist, which the Exchange must exercise within more or less broad limits from its inception.

Inasmuch as all date producers doing business with the Exchange must at the least execute a general agency agreement with it, these particular duties and obligations are a part of this document. Important among these are:

(a) Exchange will set uniform minimum prices to govern date transactions of its members;

(b) Exchange will accredit packing houses through which alone is the fruit of its members to be packed;

(c) Exchange will establish standards of grades for wholesale transactions;

(d) Exchange will establish standards of containers for the wholesale date trade;

(e) Exchange will furnish all available market information to its members;

(f) Members agree to Exchange setting minimum prices and approving containers and grades for all wholesale transactions;

(g) Members agree to clear all wholesale transactions through the Exchange;

(h) Exchange agrees to collect the proceeds from such wholesale transactions and to remit the same promptly to its members, less only direct costs of collection, if any, and a deduction of not to exceed one cent per pound, for general office, administrative and research expenses of the Exchange, including deductions for reasonable reserves, which deduction shall be uniform for all members;

(i) Member agrees to pack dates only through packing houses accredited by Exchange;

(j) All records of either party shall be open to the reasonable inspection of the other, but all information so obtained is to be held strictly confidential;

(k) Exchange is to handle all claims of its members and to do so on a cost basis;

(l) This agreement covers only wholesale transactions.

In case the Exchange contracts to undertake the sale of part or all of member's dates, it is provided in the sales agency agreement covering such function, that all direct costs of such sales effort shall be borne by the members for whose benefit the campaign was waged.

Present Status of Organization

The various agreements to give legal effect to this plan are now in the hands of your committee's counsel, in what we believe to be final form. So soon as these may be returned and finally accepted by the committee, it is planned to present them to the producers of the industry just as quickly as possible, since at best the time elapsing before the 1933 crop is ready for the market, is very short.

Conclusion

It has been my privilege to act as chairman of your committee. Therefore, in concluding these brief observations, I take particular pleasure in recording what is to me perhaps the outstanding evidence of promise for the future of the Exchange. I refer to the fact that your committee, though representing so well the diverse views of the date producers, has with much patience devoted itself through the long hours involved in the preparation of the proposed plan and has been able to unite so unanimously on as extensive a program as the one contemplated.

In my view as an individual, should you growers who constitute the California date industry, give that assent to this plan which alone can call it

into being, the success of your committee in working together to so reasonable a result, augurs well for the future of the Exchange and therefore of the industry.

In the view of your committee, the plan as outlined provides a place for every legitimate Coachella Valley date producer. My earnest hope is that as soon as the opportunity is tendered you, all these places will be filled and filled promptly.

Notes on Rain Damage to Varieties at the U. S. Experiment Date Garden

By Roy W. Nixon, Associate Horticulturist, U. S. Department of Agriculture
Indio, California

SINCE 1923 the writer has observed the ripening of date varieties at the U. S. Experiment Date Garden every season with one exception and has made notes on the damage done to these varieties by rains that have occurred during this period.

While the commercial production of dates in the Coachella Valley is largely confined to the Deglet Noor, whose reaction to rain is now well known, among newcomers and prospective date growers there is still some occasional interest in other varieties and in other localities where because of greater rainfall or humidity the Deglet Noor does not do well, the variety question in relation to rain damage is of paramount importance. It may be worth while, therefore, in connection with the subject of rain damage, to list the varieties grown at the U. S. Experiment Date Garden and summarize briefly the observations which have been recorded following rains.

First it should be noted that the use in recent years of the term "rain-resistant" as applied to date varieties has often been somewhat misleading. It is not by accident that date culture has been confined since prehistoric times to the arid and semi-arid regions of the Old World. Every variety that has been under observation at the U. S. Experiment Date Garden or elsewhere for any length of time has under some conditions been injured more or less by rain or high humidity. It is true, however, that some varieties survive occasional rains with less damage than others and such varieties are sometimes spoken of as "rain-resistant" varieties.

Three types of rain damage may commonly be distinguished: (1) Severe splitting of the skin and flesh of the date in the late "khalal" stage due to direct contact with water. This is the period just before ripening when the fruit is some shade of red or yellow according to variety.

(2) Fruit spots due to fungi fostered by high humidity. These are principally the "brown spot" (fungi **Alternaria** and **Helminthosporium**) and the "calyx-end rot" (fungi, **Aspergillus niger** and **Citromyces ramosus**) described by Fawcett and Klotz in Bulletin 522 of the University of California. The infections usually start in the late khalal stage.

(3) Fermentation and souring of dates most likely to begin in the "rutab" or fresh-ripe stage. No attempt has been made in recording these observations to distinguish between fermentation and souring, or the extent to which such changes in composition may be associated with the activity of the fungi mentioned above. Reference is made here only to dates which ferment or sour without developing the characteristic symptoms by which brown spot and calyx-end rot are commonly identified in the field.

In many varieties, particularly the softer ones, contact with rain may result in a more or less pronounced deterioration in appearance due to the skin becoming sticky with concentration of sugar on the surface.

Another type of rain damage should be mentioned. Observations during the past few years indicate that rain or moisture occurring at the period just prior to the acquisition of the red or yellow color characteristic of the khalal stage may be responsible for small lineal ruptures in the skin. These ruptures tend to heal over, but the scars remain and if numerous the appearance and grade of the date may be injured. In the Deglet Noor variety injury of this character is associated with and probably largely responsible for blacknose. In other varieties the checking of the skin may be distributed more generally or irregularly over the entire date. This type of injury has not yet been sufficiently studied to permit of any general comparison of varieties, but as far as those grown commercially in Coachella Valley are concerned it does not seem to be of any consequence except as regards the blacknose of Deglet Noor which in some seasons and in some localities is a source of considerable loss.

It will be evident from the manner in which the fruit is damaged that the relative maturity of the date at the time the rain occurs has much to do with the amount of injury that results. Fruit very immature or fully ripe may be injured very little as compared with fruit of the same variety in intermediate stages. It is also well-known to growers that the conditions under which a rain occurs may determine to a large extent the amount of damage. Sometimes a relatively heavy rain of short duration, if preceded and followed by clear weather and low humidity, may cause less damage than a much lighter rain over a longer period of time accompanied by cloudy weather and high humidity. In most of the dry and semi-dry varieties fruit spots have sometimes been observed to dry up in clear weather following a rain, apparently having been checked by low humidity.

The notes which follow are based on field observations of fruit which has not been covered or protected in any way. While some of the fruit at the station has been protected, and damage avoided in some instances, coverings alter the conditions to which the fruit is subjected and it is basic to a consideration of rain protection to know first what happens when there is no protection. Hence the practice has been followed of leaving some bunches of all varieties entirely exposed. If equal in other respects the variety least injured by rain when unprotected is most likely to be of value for planting in the more humid prospective date regions. Of course, it is possible that further experimental work may evolve improved methods of protecting and handling dates under humid conditions whereby any variety could be ripened successfully in

spite of occasional rains. But even so, economic considerations are likely to prevent the extension of commercial date culture very far beyond the climatic limitations which nature has imposed.

Inasmuch as rains occur infrequently in Coachella Valley and seldom under exactly the same conditions or when the fruit is in the same stage of maturity, and further because observations in case of most of the non-commercial varieties have been limited to only a few palms, the results noted cannot be taken as absolutely final. But whether further observations under different conditions may vary the estimate of any particular variety one way or another, the present record may be of some value as an index for further tests.

There are sixty named imported varieties growing in orchard form at the U. S. Experiment Date Garden along with several unknown imported varieties and a few selected seedlings. Only forty varieties are included in the following list as the others have been planted more recently and most of them have not yet come into bearing.

Varieties Represented in Commercial Plantings

Barhee: has been damaged a little by splitting but only slightly by fruit spots or souring.

Dayri: damage from splitting has been intermediate between Barhee and Deglet Noor; loss from fruit spots and souring has been slight. Incidentally, the texture and quality has generally improved when ripening occurred during humid weather due to the tendency of this semi-dry variety to produce a large proportion of inferior dry dates during periods of low humidity.

Deglet Noor: one of the most susceptible of all varieties to splitting and fruit spots, but sours less readily than many of the soft varieties.

Halawy: this variety has a very good record for surviving occasional rains, yet in some instances rain coming just as the fruit was beginning to ripen has resulted in souring in the middle of the broad, very compact bunches. Proper thinning early in the seaon and prompt handling after rain would probably have prevented most of the damage that has been observed.

Hayany: damage has generally been somewhat less than to Deglet Noor and due mostly to souring.

Iteema: fruit splits about like Deglet Noor but is less subject to fruit spots; one of the most susceptible of all varieties to fermentation and souring, frequently an entire loss as the result of only a slight rain.

Khadrawy: rain has caused many dates in khalal stage to split in deep ruptures; damage as far as fruit spots and souring are concerned has been only slightly greater than Halawy.

Khalasa: has been damaged to some extent by splitting but only slightly by fruit spots or souring.

Kustawy: has been damaged only slightly by splitting, fruit spots or souring.

Maktoom: has split less than nearly any other variety; has been damaged very little by fruit spots but has soured more than Kustawy or Khadrawy; deteriorates in appearance and quality following a rain rather more than the average.

Rhars: has split badly and there have been heavy losses from souring after even light showers.

Saidy: has not been seriously damaged by splitting although deep ruptures sometimes occur; injury from fruit spots has generally been less than for Deglet Noor except for the greater prevalence in some instances of calyx-end rot with considerable shattering of fruit. It is more subject to souring than Deglet Noor. Our experience has been that the shattering can be decreased by withholding irrigation during the ripening season.

Sayer: intermediate as regards splitting; has been damaged only slightly by fruit spots or souring.

Tazizoot: has been badly damaged by splitting and souring.

Thoory: has not been seriously damaged by splitting usually confined to rather small ruptures near the stem end; damage from fruit spots and souring very slight.

Zahidi: intermediate as regards splitting, fruit spots and souring.

Varieties Not of Present Commercial Importance

For convenience and brevity rain damage is noted by letters and numerals as follows:

A, Splitting of fruit; B, Fruit spots; C, Fermentation and souring.

1, Very little damage; 2, Moderate amount of damage; 3, Serious damage.

Amhat (soft: A-3, B-1, C-3.

Areshty (semi-dry): A-3, B-3, C-3.

"Azmashi" (dry): A-3, B-2, C-1.

Baydh Hamman (soft): A-3, B-1, C-2.

Bentamoda (semi-dry): A-3, B-2, C-2.

Bent Keballa (soft): A-3, B-1, C-3.

Besser Haloo (dry): A-1, B-1, C-1; escapes most of the fall rains because of early ripening.

Braim (soft): A-2, B-2, C-2; this variety is of interest in that its khalal fruit has very little tannin and it is harvested in that stage in Southern Iraq.

Dubaini (soft): A-1, B-1, C13.

Fursee (semi-dry): A-1, B-2, C-1.

Gantar (soft): A-1, B-1, C-1.

Hellali (soft): A-1, B-1, C-2; very late ripening and consequently quite immature in fall. Winter rains bring about more or less deterioration.

Horra (dry): A-2, B-1, C-1.

Jozee (dry): A-1, B-2, C-1.

"Koroch" (soft): A-2, B-1, C-1; escapes most of fall rains because of early ripening.

"Kush Batash" (soft): A-2, B-1, C-1.

"Kush Shehan" (soft): A-1, B-1, C-3; shatters badly.

Kush Zebda (soft): A-3, B-1, C-1.

Menakher (semi-dry): A-3, B-2, C-2.

Nakleh Zian (soft): A-3, B-1, C-2; escapes most of fall rains because of early ripening.

Okt Fteemy (soft): A-3, B-1, C-1.

Safraia (dry): A-2, B-1, C-1; escapes most of fall rains because of early ripening.

"Shatwi Asfar" (soft): A-1, B-1, C-3.

"Shukkar Nabat" (soft): A-3, B-1, C-3.

(Note: Identity of varieties in quotations is questionable.)

Date Protectors: What They Are

By Bruce S. Boyer, Indio, California

VARIOUS materials have been used, among which are paper sacks, paper tubes, barley sacks as sacks and cut to make square sheets, and 8 and 10 oz. burlap originally cut to size 3x6 feet, and muslin, both natural and water-proofed.

Purposes:

It was originally expected that these covers would serve three purposes, rain protection, protection from birds, and assist in the ripening processes of the fruit by reason of controlled temperature and humidity. The latter thought seems to have been pretty largely dropped from the minds of the growers at this time.

Development

In the year 1919 Mr. Bruce Drummond, superintendent of the Government Date Garden at Indio, made bags from medium heavy wrapping paper. This was accomplished in his work room with the aid of a glue pot. In some of these bags a hole one inch in diameter was cut; in others, two inches, and six inches in diameter, the idea being to give ventilation. The result of this year's experiment seemed to show that no opening in the bottom for ventilation was needed. However, the value as a rain protector was evident.

The home-made bags did not seem very durable, so a double layer "Ripple Kraft" asphalt-filled bag of great strength and resiliency, sewed across one end was found for the 1920 experiments. Many of the growers were interested by this time so the experiment spread from the Government Date Garden to various private parties. The result was disastrous. The asphaltum gathered heat and retained moisture given off by the fruit, making an ideal propagating plant for Alternaria, Helminthosporium and the various fungii that tend to ruin the fruit after any long extended spell of moist, warm weather.

Profiting by the experience related, the next move was to try single layer, unfilled "Ripple Kraft" tubes for the following season. While not 100 per cent protection, these proved quite satisfactory and are being used more generally each succeeding season. The sizes mostly used are 36x 40 and 40x40.

It is always a question as to the time to place these covers on the bunches as there have been seasons when the fruit had attained sufficient sugar to permit cracking of the skins during rainy weather late in the month of August; therefore, to be absolutely safe the protectors should be placed on the bunches at that time, though they are usually placed in the early part of September.

It seems a good practice to place the covers in August, leaving the bottom edge pushed well up on the inside, thus forming a canopy but allowing free circulation of air and natural exposure to the rays of the sun for a time. Later the skirts may be pulled down and left so the balance of the season. The advantage of having this canopy in the early season is that, should a rain storm occur there would be considerable protection afforded as well as having the time-taking labor of tying the covers around the fruit stems done well in advance of the oncoming busy season.

About the season 1921 one of our growers, Mr. Robert Barker, I believe, conceived the idea of using second-hand barley sacks cut open and wrapped around the bunches. His first experience was more or less satisfactory. The duability of this kind of covering appealed to a number of growers. These men bought quantities of new burlap covers made up and measuring 3x6 feet. Some of these were still being used for the 1932 crop.

It is pretty generally conceded that this sort of covering not only allows a small amount of rain to penetrate to the fruit, but also takes longer to dry; therefore, the fruit loss is heavier under burlap than under paper.

Mr. Cowgill used waterproofed muslin for a time with varying degrees of success, but had many bunches of the 1932 crop protected with paper covers.

Parafin - filled light - weight muslin selling under the trade name of "Vito Cloth" has been experimented with the past two or three years. Newspaper articles have appeared on the success of this material as a covering in Arizona. One of the points claimed for this material is that it admits the violet rays of the sun, thereby assisting the fruit in its ripening processes. The writer is not particularly impressed with Vito Cloth for the Coachella Valley 'at this time though it must be admitted that as a protection against rain it is one of the best.

Probably the most unique cover yet constructed was made by Mr. Art LeGrand for the Season 1932. This was entirely an experiment, only a very few being made. A few were placed on the Government Date Garden and two on the writer's date garden. This protector was small at the top to fit that part of the bunch and large at the bottom to encircle the fruit. The material reminding one of the old-fashioned raincoat, but of a higher class.

Steel ribs were placed on the inside to hold the cover somewhat away from the fruit and when placed was fastened together by a "zipper." A cape of the same material was placed above and fastened to the cover by means of a piece of netting; the same netting being used as protection to the bottom of the bunch, thereby providing ventilation at both top and bottom.

This cape was provided with a short piece of small resilient rubber hose at the top which came in direct contact with the fruit stock, and thus tied absolutely, preventing any rain from passing down the stem to the fruit. The cape was also held together by a snap button a little farther down.

Like the asphalt-filled paper covers, this protector gathered too much heat and the fruit was burned. Also, like the asphalt, the plant moisture seemed to hang around the fruit too long, causing an excess of dropping. The cost of this type of cover was not learned but was probably pretty heavy.

Last season our Association bought ripple kraft "Arksafe" tubes, 36x32, $28.00 f. o. b. New York; 36x40, $33.00 f. o. b. New York

Our quotations for the present year for Elasticraft tubes are: 36x40, $35.50 delivered Los Angeles Harbor; 40x40, $38.70 delivered Los Angeles Harbor.

We are also being offered "Double Elastikraft" (rippled in both directions), at the following prices: 36x40, $52.05 delivered Los Angeles Harbor; 40x40, $56.75 delivered Los Angeles Harbor.

In conclusion I want to say that while spoiled and good fruit on many bunches have been counted by myself and the growers, the actual saving that can justly be credited to covers has not yet been determined. Notwithstanding this, the growers, having year after year seen heavy rain damage on uncovered bunches as compared to covered bunches, have definitely decided that covering pays.

Preliminary Report On the Use of Water by Dates

By M. M. Winslow, University of California

THE University of California has made an extensive investigation of the use of water by citrus and walnut trees in Southern California. These studies have had an important bearing upon the amount of water to apply and the intervals between irrigations. It is necessary, of course, to have at all times a supply of available moisture in the root zone of any crop, in order to secure the highest yields of good quality.

Little was known about the amount of water used by dates and since there were reports of the heavy use of water, the University of California undertook in 1932 a preliminary investigation of the use of water by dates in the Coachella Valley. This work has been reported upon by Arthur F. Pillsbury, junior irrigation engineer; and table attached is a summary of this data. It should be pointed out that this data is not conclusive.

The amount of water used by the palms is given in acre inches. An acre inch of water is the quantity required to cover the surface of an acre one inch in depth, and is equivalent to one inch in rainfall. A rancher can determine the amount of water he is applying by the following formula for pumped water:

Gallons per minute times hours run, divided by 450 times number of acres, equals acre inches per acre.

Since the amount of water lost from different depths of soil is a fair index of root distribution, it will be seen upon referring to the accompaning table that most of the effective roots are found in the first six feet of soil. Upon the basis of these figures it would seem that irrigation water penetrating to a greater depth than six feet is of little value to the date palm.

Extensive studies have definitely shown that the upward movement of moisture from below by capillarity is negligible in the absence of a free water table. Where water is expensive it is a real financial loss for the grower to apply larger amounts than necessary to wet to the depth of the effective root zone.

Studies conducted with many varieties of trees clearly indicate that the amount of water used is not influenced by soil type. Soil type or texture determines the water holding capacity of the soil and has an important influence upon the rate of water penetration. Important factors influencing water use in the apparent order of their importance are: leaf surface, amount and intensity of sunlight, temperature, humidity, and wind movement.

The data presented should stimulate a desire upon the part of the date grower to make soil examinations to determine the depth of water penetration following an irrigation, and frequent examinations to determine the extent of the drying out of the soil in order to determine when another irrigation is required. In this way the water requirements of the palm can be more adequately taken care of at a lower cost for water than is now the case of some gardens.

SOIL-MOISTURE LOSS IN CERTAIN DATE GARDENS
—1932—

Location Interval of Sampling Soil Type	Depth of Soil Sampled in Feet 0 to 2	2 to 4	4 to 6	6 to 8	8 to 9	Total	Equivalent Loss in 30 Days	Depth of Moisture Penetration--Ft.
	Acre-Inches per Acre							
1. Boyer Garden Indio loam								
May 5 to May 16	3.08	0.12				3.20	8.76	2 5
Aug. 1 to Aug. 9	2.40	0.17				2.57	9.67	
2. Cowgill Garden Coachella very fine sand								
June 6 to June 20	0.88	3.01	1.29	0.15		5.33	11.42	7.0
3. Menakher Garden Coachella very fine sand								
July 2 to July 11	1.87	0.32				2.19	7.29	
Aug. 15 to Aug. 24	1.68	0.27				1.95	6.48	2.0
Nov. 4 to Dec. 5	2.57	1.22				3.79	3.67	
4. Narbonne Ranch Coachella fine sand								
Oct. 12 to Dec. 7	2.63	3.03	1.22			6.88	3.69	5.5
5. A. J. Shamblin Garden Indio very fine sandy loam								
Oct. 14 to Dec 6	2.08	2.67	1.49	0.41	0.20	6.85	3.87	18.0